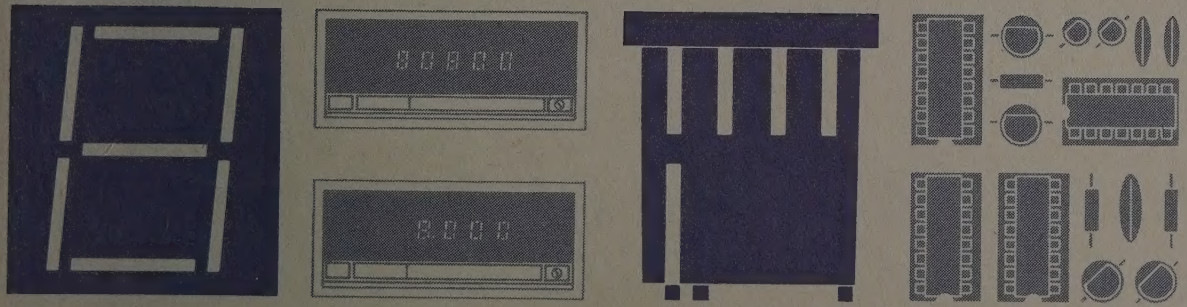
model 2770A
dc panel meter

METER ROOM

3 1/2



DigiTec. Instrumentation

WARNING

This instrument is designed to prevent accidental shock to operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to do so can result in a serious or fatal accident.

SHOCK HAZARD (As defined in Underwriters Laboratories Radio and Television Receiving Appliances Standards for Safety, Twelfth Edition, dated June 25, 1969.)

"Shock hazard shall be considered to exist at any part involving a potential of between 42.4 volts peak and 40 kilovolts peak in the following cases:

A. If the current through a load of not less than 500 ohms exceeds 300 milliamperes after 0.0003 second.
B. If the current through a load of not less than 500 ohms exceeds 5 milliamperes after 0.2 second.
C. If the time required for the current through a load of not less than 500 ohms to decrease to .5 milliamperes is between 0.1 and 0.2 second, and the total quantity of electricity passed through the load up to that time exceeds 4 millicoulombs.
D. If the time required for the current through a load of not less than 500 ohms to decrease to 5 milliamperes is between 0.03 and 0.1 second, and the total quantity of electricity passed through the load up to that time exceeds $75T\text{-}350T^2$ millicoulombs, where T is the time in seconds.
E. If the potential is more than 5 kilovolts peak and if the total capacitance of the circuit is more than 3000 micromicrofarads.

NOTE: Additional factors might apply when potentials more than 40 kilovolts peak are present.

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SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

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model 2770A
dc panel meter

1. GENERAL INFORMATION

1.1 Unpacking and Shipping

After unpacking, carefully examine the instrument for physical damage that may have occurred in transit. If any damage is noted, immediately contact United Systems Corporation for further instructions.

If it should become necessary to return the instrument to United Systems Corporation, repackage in original carton or make certain that at least four inches of padding material surrounds the instrument to prevent damage during shipment. When returning instruments to the factory, give a full description of the failure of the instrument and the mode of operation that was used when the instrument failure occurred.

Ship via UPS, motor truck, or air freight PREPAID to:

UNITED SYSTEMS CORPORATION
918 Woodley Road
P.O. Box 458
Dayton, Ohio 45401

Countries outside the United States and its possessions should contact our local representative for instructions.

CAUTION

The anti-static strip on the rear edge terminals MUST be retained and applied to the instrument before reshipping. If the alarm option board (option C) is shipped separately, the anti-static strip must first be installed on the edge terminals and the board must then be placed into a black anti-static bag before shipping.

If the anti-static strip has been misplaced, wrap the instrument or circuit board with aluminum foil before shipping.

1.2 Instrument Identification

The instrument model, serial number, and other pertinent data are given on the identification tag on the bottom of the instrument.

1.3 Technical Characteristics

Model	Range	Resolution	Accuracy @ 23°C ±3°C <85% r.h.	Input Z	Overload Protection (DC or AC Peak)
2770A-00	±19.99 mV	10 μV	±0.055% Rdg. ± 0.05% F.S.	1000 meg	100V
2770A-01	±199.9 mV	100 μV	±0.05% of reading ± 0.05% of Full Scale		20V
2770A-02	±1.999V	1 mV			200V
2770A-03	±19.99V	10 mV		10 meg	1200V
2770A-04	±199.9V	100 mV			
2770A-05	±1000V	1V			
				SHUNT	
2770A-08	±199.9μA	0.1μA	±0.1% of reading ± 0.05% of Full Scale	1K	30 mA
2770A-09	±1.999 mA	1 μA		100 ohm	100 mA
2770A-10	±19.99 mA	10 μA		10 ohm	300 mA
2770A-11	±199.9 mA	100 μA		1 ohm	1A
2770A-12	±1.999A	1 mA	±0.2% of Rdg. ±0.05% of F.S.	0.1 ohm	3A

Temperature Coefficient:

Model 2770A-00	±0.005% Reading ±0.01% Full Scale/°C
Models 2770A-01 thru -05	±0.005% Reading ±0.002% Full Scale/°C
Models 2770A-08 thru -12	±0.008% Reading ±0.002% Full Scale/°C

Response Time: 850 mSec to 99.99% of DC step change; except 2770A-00: 1 Sec

AC Rejection: Common Mode: 120 dB @ DC
>80 dB @ 50/60 Hz
Maximum common mode voltage = 500Vdc or peak ac
Normal mode: 35 dB @ 50/60 Hz; except Model 2770A-00: 60 dB

Sample Rate	4 per second nominal
Input Bias Current*	100 picoamps nominal; except Model 2770A-00: 10 mA nominal
Overrange Indication	Display flashes approximately 2 times/second; overrange bit comes true
Continuous Sample	Normal operation, no jumpers required
Sample Inhibit	Sample can be inhibited and reading retained by applying Logic 0 or ground to the $\overline{\text{sample inhibit}}$ input or by applying Logic 1 to the sample inhibit input.
BCD Output ("E" & "N" Option)	Parallel 8-4-2-1 BCD for all digits. TTL Compatible Logic

"E" Option	"N" Option
Logic 1 = +2.4V Min @ 100 μA Source	Logic 1 = +2.4V Min @ 0.4 mA Load
Logic 0 = +0.4V Max @ 1.6 mA Sink	Logic 0 = +0.4V Max @ 1.6 mA Sink

Reading Retention Enable ("E" Option only)	TTL Logic 1 (+3.5V Min to +5V) retains last BCD reading TTL Logic 1 (+3.5V Min to +5V) or open enables all BCD output lines. TTL Logic 0 (0 to +0.8V) causes all BCD output lines to assume a third high impedance state.
Operating Ambient	+50°F to +122°F +10°C to +50°C
Power Requirements	105/125V or 210/250V 50/400 Hz, 2.5VA Option "R" only: 5 volts ±5%, 500 milliamps
Dimensions	4.39W X 1.89"H X 4.50"D 11.15cm W x 4.8cm H x 11.43cm D

*Stated at 23°C ±3°C @ less than 85% R.H.

Mounting Hole	3.75" X 1.72" 9.53 cm X 4.37 cm
Weight	Net: 1 lb. Shipping: 1-1/2 lbs. 0.45 kg 0.675 kg

ALARM OPTION
(Option "C")

NOTE
All inputs used for TTL logic require a pull-up resistor, not to exceed 10K ohm, from each input to +5 VDC.

INPUTS

BCD Alarm Input & Polarity (See Section 2.9.3)	1. Programmable by jumpers on rear connector 2. Programmable by external BCD switch or Model 772 switch accessory 3. Programmed by external TTL compatible logic levels. Logic level must be coincident with strobe output.
Alarm Mode	Self Resetting: TTL compatible Logic "0" or open Latch and Hold: TTL compatible Logic "1" or +5VDC
Alarm Reset	TTL Logic "1" or +5 Vdc resets alarm
Alarm State Selection	

Status of Alarm Select (J2, Pin A15)	*Input Signal Level	Status of Relay Contact (J2, Pins 16 & 17)	Status of Alarm Output (J2, Pin B17)
Logic "1"	Below Level	Closed	Logic "1"
	Above Level	Open	Logic "0"
Logic "0"	Below Level	Open	Logic "0"
	Above Level	Closed	Logic "1"

***NOTE:** Positive Polarity, "Equal To" is same as below level.
Negative Polarity, "Equal To" is same as above level.

Sample Inhibit	Logic "0" inhibits sampling

OUTPUTS

Output Logic	Logic "1" I Source = 1 mA @ 2.5 Vdc Logic "0" I Sink = 2.5 mA @ 0.4 Vdc
Alarm Outputs	Output is true (Logic "1") within 20 mS of end of sample
Data Strobe Output	External BCD input must be in synchronism with the appropriate data strobe Logic "1" output.
Relay Output (Contact Limits)	70 Vdc @ 100 mA
(Contact Limits)	Do not exceed 7.5 VA, 0.5A carry current
+5 Vdc Output	Available for rear panel programming only. **This output is not to be used to operate external loads.**
Power/Analog Connector	Cinch 50-30EE-30 (our P/N 51-07548-15)
BCD Connector ("N" Option Only)	Cinch 50-24EE-30 (our P/N 51-07548-12)
Alarm Connector ("E" Option Only)	P/N 51-16848

1.4 Precautions

The input and BCD connectors are keyed with the pin numbers on top and the connector for the Alarm Option, Option C is keyed with the letter "B" on top. Failure to mount the connector correctly may result in permanent damage to the instrument. To operate these instruments, earth ground as well as high and low power MUST be supplied to the connector. Unstable readings may occur if the earth ground connection is deleted.

Do not apply AC power to units with a model number containing the suffix R.

The Model 2770A incorporates two (2) fuses for increased instrument protection. A current limiting fuse, F2, guards against major fault conditions (large overload); and a thermal fuse, F1, protects the instrument should a minor fault condition occur (temperature above a safe level causes thermal fuse to open).

Both fuses are "one-time" devices which must be replaced once they have opened. Part numbers for these fuses are given in the MAIN BOARD parts list in Section 6 of this manual. Their physical locations are illustrated in Figure 15.

2. OPERATION

2.1 Input Connections

2.1.1 Power Connections

All instruments have a lower connector, J1, used for line power and analog input connections. Instruments which have BCD or alarm output (Option C, E, or N) have a secondary connector, J2, located directly above J1 for interfacing with an auxiliary recording or alarm device.

The figures 3, 4, and 5 indicate the proper power connection for 115 and 230 volts AC and +5 volts DC operation.

Figure 1
Rear View of Instrument

WARNING

Power input is applied to the rear connector J1, on Pins 5 and 7 with power line ground at Pin D. Failure to use power line ground according to latest electrical code may result in a SHOCK HAZARD or unstable readings. Power connections must be properly insulated before applying power.

CAUTION

Do NOT apply AC power to units with a model number containing the suffix "R".

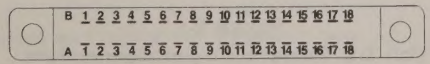


Figure 2
Alarm Option Connector

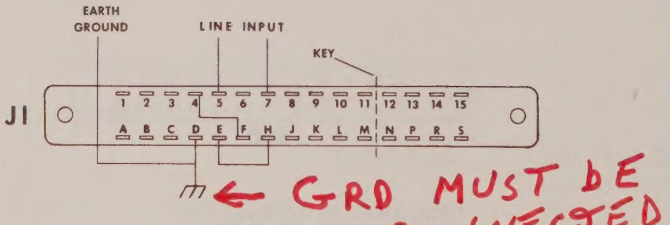


Figure 3
105/125 VAC Operation Input Connections

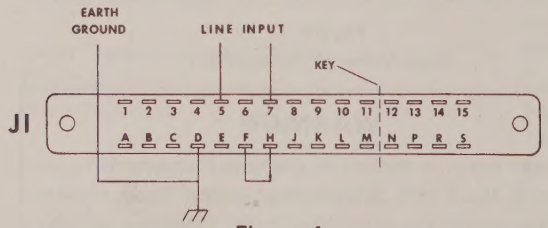


Figure 4
210/230 VAC Operation Input Connections

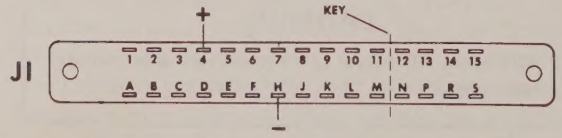


Figure 5
5 Volt DC Operation Input Connections
(R Option Only)

2.1.2 Signal Input Connections

Instrument may be either a voltmeter or an ammeter by proper connection of external resistors on the line and analog connector, J1. Optional features such as decimal point positions, and reading retention will be discussed in their respective sections.

WARNING

These instruments are designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to SHOCK HAZARD WARNING on the inside front cover of this manual.

Input terminations must be insulated before applying an input signal. For maximum safety turn off all power to the circuit being measured before connecting or disconnecting leads.

Figures 6, 7 and 8 illustrate the various input connections.

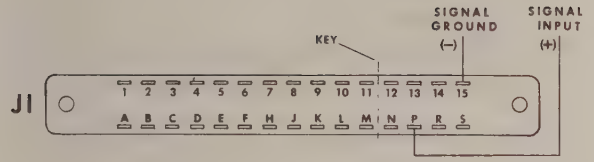


Figure 6
Model 2770A-00, -01 & -02 Input Connections

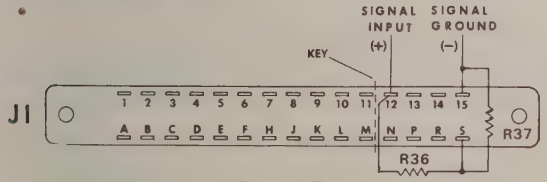


Figure 7
Model 2770A-03, -04 & -05 Input Connections

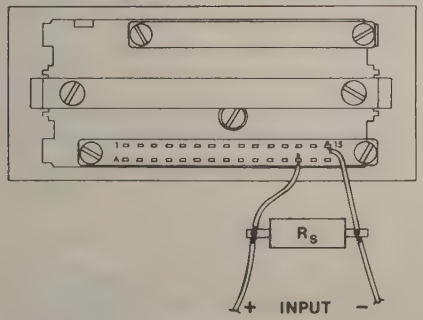


Figure 8
Model 2770A-08 thru -12 Input Connections

2.2 Decimal Point Location

The decimal point may be located in any one of three positions as determined by jumpers on the rear connector.

The chart below indicates the proper jumper location on the rear connector, J1, for each specific decimal point.

Location	Jumper
00.0	J to L
0.00	J to 9
.000	J to 10
000	None

2.3 System Interface

In order to record the data from these panel meters, the BCD Output must be prevented from updating while the data is being recorded. To inhibit the BCD, apply Logic "1" to the SAMPLE INHIBIT or Logic "0" to the $\overline{\text{SAMPLE INHIBIT}}$ during the entire recording cycle. To resume sampling, the opposite logic must be reapplied. Allow one second for stabilized reading.

In addition to sample inhibit and $\overline{\text{sample inhibit}}$, option "E" provides a special SINGLE LINE ENABLE feature. SINGLE LINE ENABLE permits numerous 2770A or 2780A Digital Panel Meters to continuously monitor any number of data sources and record the measured data using only one

printer channel; thus providing a constant visual display of all data points regardless of which point is being recorded.

To use the SINGLE LINE ENABLE feature, first connect the BCD output lines of all instruments in parallel (i.e. all BCD 1's together, all BCD 2's together, etc.). Then apply a TTL logic "0" signal to J2 Pin H to all instruments; thus causing the BCD output lines of all instruments to assume a "third, high-impedance" state. Application of TTL logic "1" to J2 Pin H of a particular instrument (selected remotely or by manual switches) will then enable the BCD output lines of that specific instrument.

For convenience, ENABLE and SAMPLE INHIBIT lines of each individual instrument may be tied together at the connector, thus allowing one line to activate the BCD output while retaining the data. DO NOT CONNECT THESE LINES TO MORE THAN ONE INSTRUMENT.

CAUTION

Enabling two or more instrument simultaneously may result in permanent damage.

AC power must be applied or removed simultaneously to all the instruments using the common bus between them.

Possible damage to the outputs may occur if all units do not have power to them.

2.4 Reading Retention

Normal sampling of these instruments can be inhibited to allow the instrument to hold a specific input voltage or current reading and the associated BCD output (if applicable) indefinitely or until an updated reading is required.

To retain reading apply:

Logic "1" to Pin M of J1 or Pin N of J2 (Logic "1"= 3.5V Min to +5V Max)

OR APPLY

Logic "0" to Pin 11 of J1 or Pin A of J2 (Logic "0" = 0 V Min to +0.8V Max)

Removing the inhibit returns the instrument to normal sampling operation. Allow one second for stabilized reading.

2.5 Check Out Procedure

Upon receipt of the instrument, the following checkout procedures should be followed:

1. Apply power (see Section 2.1.1 for details)
2. Allow thirty (30) minutes warm up.
3. Connect a jumper between signal input and signal ground (see Section 2.1.2 for details)
4. The display should read 000. If not, insert a small screwdriver into the hole on the front panel and rotate until 000 is obtained on the digital display.

NOTE

Once this control is set, the auto zero circuit will automatically compensate for any internal offsets.

5. Remove the jumper and apply an appropriate voltage or current to the input (see Section 2.1.2 for details).
6. Display should equal input voltage or current within the specifications outlined in Section 1.3. If unit does not meet specifications, recalibration may be required. See Section 2.7.

2.6 Zero Adjustment

These instruments have an automatic zero circuit to compensate for all internal offsets; however, a front panel zero adjustment is provided to permit small zero offsets in user applications.

Models	Offset
2770A-00, -01, -08 thru -12	± 12 Digits
2770A-02 thru -05	± 2 Digits

To adjust zero, the following procedure should be used:

1. Apply zero voltage or current to the input (or short input leads).
2. Insert a small screwdriver into the hole on the front panel and rotate until 000 is obtained on the digital display.

2.7 Calibration

To calibrate the instrument, the following procedure should be used:

1. Apply power (see Section 2.1) and warm up for at least thirty (30) minutes.
2. Check and adjust zero, if necessary (see Section 2.6).
3. Apply a voltage or current to the input terminals equal to a display of 1900 (see Section 2.1.2).
4. Locate the calibration adjustment screw (R5, see Figure 9) on the printed circuit board by looking through the slots in the case on the left-hand side of the instrument. Do not remove the case.
5. Insert a small screwdriver through the slot and adjust the calibration screw for 1900.

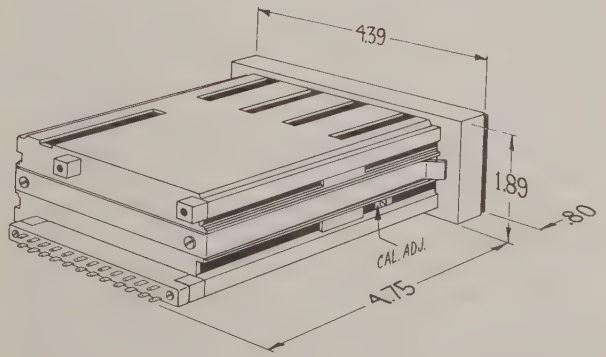


Figure 9
Outline Drawing

2.8 Rear Connector (J1)

Function	Pin		
POWER			
All Models	4, 5, 7, E, F, H		
Option "R" Only			
+5V (high)	4		
+5V (low)	H		
Earth Ground	D		
INPUT SIGNAL			
Standard Input	P		
Divider Input	S		
Signal Ground	15		
DECIMAL POINT POSITION			
Common	J		
Position (.000)	10		
Position (0.00)	9		
Position (00.0)	L		
			Logic Levels
$\overline{\text{Sample Inhibit}}$	11	—	Logic "0" = 0 to 0.8V
Sample Inhibit	M	—	Logic "1" = +3.5V to +5V
Ground	15		
+5 Volt Logic Level (50 mA Max)	8		
Logic Ground	B		

FACTORY TEST VOLTAGES	(Do not use these voltages for external circuitry)
+12V	A
-12V	1
+6.2V	13
Not Connected	2, 3, 6, 10, 12, 14, C, N, R

2.9 Comparator Alarm ("C" Option Only)

The programmable alarm option consists of a single printed circuit board that can be field installed in any Model 2770A panel meter to indicate, by relay closure or logic level output, when a predetermined limit has been exceeded. The alarm can be programmed to momentarily indicate an alarm condition only while the condition exist or to latch-up and hold when the input goes above or below the present limits. The limits can be programmed by jumpers on the rear connector or by an external BCD switch or TTL compatible logic.

To install, disassemble the instrument as outlined in Section 5; then install the printed circuit board into the top connector of the display board and reassemble.

NOTE

If TTL logic is used, each input must be pulled-up to +5 VDC through a resistor of not greater than 10K ohm.

2.9.1 Alarm Mode Selection

By the application of the proper logic to Pin A14 of connector J2, the alarm can be selected to self-reset or to latch and hold an overlimit or underlimit condition.

In the self-reset mode, the output logic will indicate an out-of-limits condition only when the condition occurs and will return to normal logic as soon as input drops below the limit condition.

In latch and hold mode, the output will latch and hold the output alarm in the logic "1" state (relay contacts open) until reset by an external signal. This state may be used to indicate either above limits or below limits as selected by the alarm state select input (see Section 2.9.2). The latch and hold condition may be reset to the normal standby state by applying logic "1" or +5 VDC to Pin A11 of connector J2.

Self-Reset: TTL compatible Logic "0" or Open

Latch & Hold: TTL compatible Logic "1" or +5 VDC

2.9.2 Alarm State Selection

The status of the relay contact and the alarm logic is determined by (1) input signal level (e.g. above or below the programmed number) and (2) the logic level of the alarm state select input at Pin A15 of J2.

The following chart illustrates the output for each combination of alarm select logic and input signal level.

Status of Alarm Select (J2, Pin A15)	*Input Signal Level	Status of Relay Contact (J2, Pins 16 & 17)	Status of Alarm Output (J2, Pin B17)
Logic "1"	Below Level	Closed	Logic "1"
	Above Level	Open	Logic "0"
Logic "0"	Below Level	Open	Logic "0"
	Above Level	Closed	Logic "1"

***NOTE:** Positive Polarity, "Equal To" is same as below level.
Negative Polarity, "Equal To" is same as above level.

2.9.3 Alarm Programming

Any number from -1999 to +1999 can be programmed via the rear connector by using jumpers on the rear connector, using external TTL compatible BCD logic, an external BCD switch, or our Model 772-3 rear panel programming switch.

Using jumpers — to program a fixed number, first convert the desired number to BCD notation; then connect jumpers from the BCD inputs on the rear connector to the STROBE output for the desired decade. The polarity sign is wired directly to the +5V output to indicate the positive (+) polarity.

Example:

If the desired program number is +1825, the connections for the required jumpers are as follows:

Function	Pin #	Jumpered to	Pin#	Notes
Polarity	A13	+5V	B1	Positive Polarity
B1000	A7	1000's Strobe	B16	The Number 1000
BCD 800	B5	100's Strobe	B15	The Number 800
BCD 20	A5	10's Strobe	B14	The Number 20
BCD 1	A10	Units Strobe	B13	The Number 5
BCD 4	B11	Units Strobe	B13	

Using external TTL compatible BCD input — An external, TTL compatible, BCD logic can be used to control the alarm providing logic "1" is applied to the appropriate BCD inputs (i.e. BCD 1, 2, 4, 8, 10, 20, 40, etc.) in **synchronous** with the appropriate strobe output signal (units strobe, 10's strobe, etc.). To insure dependable operation, using TTL logic all inputs should be pulled up to +5V (Pin B1) via a resistor of not greater than 10K ohms.

If this type of Logic is not available, please refer to our Model 2770AE or 2770AN (Panel Meter with BCD output) in combination with our Model 684 Comparator.

Using an external BCD switch — To use an external switch, connect BCD 1, 2, 4, and 8 to the UNITS DECADE, and the units strobe to the common switch terminal. Repeat the same sequence for the TENS and HUNDREDS decades using BCD 10, 20, 40, 80 and the 10's strobe and the BCD 100, 200, 400, 800 and the 100's strobe respectively.

Using the 772-3 Programming Switch — The Model 772-3 Programming Switch allows screwdriver adjustment of the alarm number. To use, simply insert the switch connector on to the printed circuit edge projection and select the desired number. See the 772-3 instruction sheet for programming connections.

2.9.4 Input/Output Connector, Option "C"

All inputs and outputs are located on the top connector. This connector must be inserted with Pin B18 in the top right-hand corner.

Function	Pin	Function	Pin
BCD 1	A10	BCD 100	A8
BCD 2	A6	BCD 200	A4
BCD 4	B11	BCD 400	B9
BCD 8	B7	BCD 800	B5
Units Strobe	B13	100's Strobe	B15
BCD 10	A9	BCD 1000	A7
BCD 20	A5		
BCD 40	B10		
BCD 80	B6		
10's Strobe	B14		
BCD Ground	A18	Alarm State Select	A15
		Alarm Mode Select	A14
		Alarm Reset	A11
Polarity	A13		
Sample Inhibit	B18	Alarm Output	B17
		Alarm Ground	A18
+5 Volts	B1	Relay Contact	A16
Logic Ground	A18	Relay Contact	A17

2.10 BCD Output Connector J2, ("E" & "N" Options Only)

Instruments containing an "E" or "N" suffix to the model number have positive true, TTL compatible BCD output.

Logic levels for "E" option are:
Logic 1 = +2.4V Min @ 100 μA Source
Logic 0 = +0.4V Max @ 1.6 mA Sink

Logic levels for "N" option are:
Logic 1 = +2.4V Min @ 0.4 mA Load
Logic 0 = 0.4V Max @ 1.6 mA Sink

Functions and pin numbers are given below.

Function	Pin
BCD 1	B
BCD 2	D
BCD 4	4
BCD 8	C
BCD 10	3
BCD 20	E
BCD 40	6
BCD 80	5
BCD 100	F
BCD 200	K
BCD 400	10
BCD 800	9
BCD 1000	L
BCD 2000 (Overrange)	12
Polarity Bit	11
+5 Volt Logic Level	J
Logic & BCD Ground	2
SYSTEM INTERFACE	
Sample Inhibit (Logic "1" inhibits)	N
Sample Inhibit (Logic "0" inhibits), TTL compatible	A
Enable (E option only) (Logic "1" enables)	H
Not connected	M, 8, 7

Logic "1" = 3.5V Min

Logic "0" = 1.5V Max

Logic "1" = 3.5V Min

3. INSTALLATION

These panel meters are designed to install into a 3.75" x 1.72" hole. To install, remove the two mounting bracket retaining screws and the mounting bracket. Slide the instrument in from the front and reinstall the mounting bracket and retaining screws (see Figure 12).

These instruments may be installed into panel openings designed to accept the DigiTec Models 271, 272, or 275 by inserting an adapter plate between the instrument and the panel. This adapter plate (P/N 34-13357) is available from the factory upon request.

4. CIRCUIT DESCRIPTION

Analog to digital conversion is accomplished by using an analog (see Figure 10) and a digital processor (see Figure 11).

The analog processor consists of an integrator, a comparator, an auto zero circuit and a pulse width modulated reference current.

The input (measured signal, "M") is applied, through a buffer, to an integrator. The output of the integrator is then compared to the output of an auto-zero buffer. If the output of the comparator is above zero, the input of the integrator will be driven down (D) by applying ground to the input of the integrator for 7 clock pulses and Vref (v) for one clock pulse. If the input of the comparator is below zero, the input of the integrator will be driven up by applying Vref (v) for 7 clock pulses and ground (D) for 1 clock pulse.

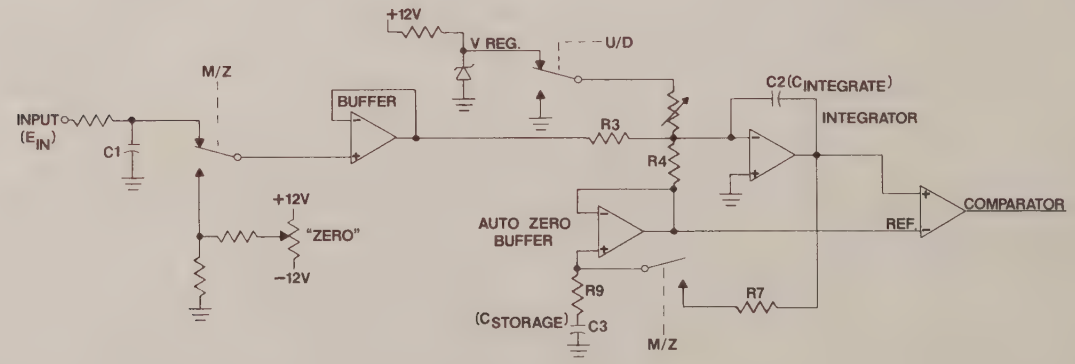


Figure 10
Block Diagram, A/D Section

This continues for 4028 clock pulses. At this time the input buffer is switched from the input signal (M) to the zero reference (Z) and a charge is placed on C3 to automatically compensate for any drift in the measuring circuit.

At the same time the digital processor totals the ground clock pulses and the subtracts them from the Vref clock pulses using an up/down counter. The difference being a BCD representation of the analog input (M).

The BCD is decoded with a BCD to 7 segment decoder and strobed on digit at a time into the LED displays.

5. MAINTENANCE

If the instrument operates, but is inaccurate, calibrate before troubleshooting (see Section 2.7).

5.1 Disassembly

WARNING

Remove all power and input signal before removing the rear connectors.

To disassemble the instrument from the case, remove the mounting bracket retaining screws, mounting bracket, and the circuit board retaining screw. Hold the instrument with both hands and use your thumbs to push on the edge connector portion of the circuit boards that extend from the rear of the case until the edge of the board is flush with the case.

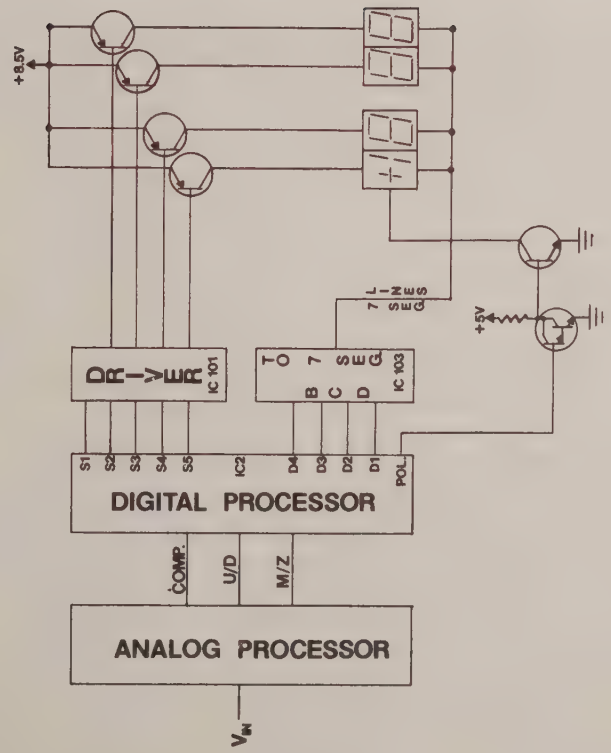


Figure 11
Block Diagram, Digital Section

The internal circuit board assembly can now be gently pulled from the front of the case. The display window, which will remain attached to the display board, can be taken off by removing two (2) window retaining screws from the rear of the display board.

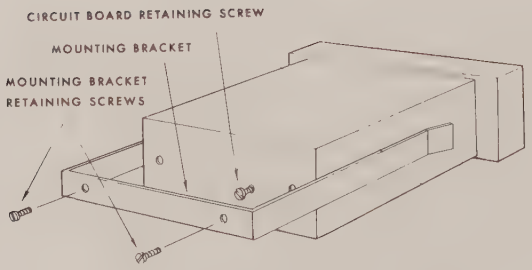


Figure 12
Assembly Drawing

5.2 TROUBLESHOOTING

Symptoms	Possible Cause
Instrument completely blanked	1. No power applied to the instrument 2. Defective fuse resistor, R23 or defective thermal fuse, F1 3. Defective +5 volt regulator, IC6
Reading will not change with changing input	1. Sample inhibit or $\overline{\text{sample inhibit}}$ is activated, see Sections 2.3 and 2.4. 2. Defective IC3 A. Check IC3, Pin 3 for a ≃30 KHz clock signal B. Check IC3, Pin 11 for a logic "1" level
Display blanking at an ≃2 Hz rate	1. Input voltage or current exceed maximum range — this is normal operation. 2. Input terminals open on Models 2770-01 and -02 — this is normal operation.

6. REPLACEMENT PARTS

Replacement parts for the components shown on schematics and component location drawings are listed in alphanumerical order by reference designator under their respective assemblies. It is recommended that replacement parts be purchased directly from United Systems Corporation or one of its authorized service centers. The minimum charge is $25.00 on all orders.

For each replacement part the following information should be included:

Instrument Model Number
Instrument Serial Number
Part Reference Designator
Part Description
Part Stock Number

MAIN BOARD
(Logic and Power Supply)

Ref. Des.	Description	USC Stock Number	Vendor
C1	Capacitor, 0.1 mF @ 250V	56-16873-104H2R5	Siemens Type MKH
C2	Capacitor, 0.22 mF @ 250V	56-16873-223H2R5	Siemens Type MKH
C3	Capacitor, 0.068 mF @ 250V	56-16873-683H2R5	Siemens Type MKH
C4	Capacitor, 500 pF @ 1000V	56-10215F501JC10	Centralab DD, C1, DC, CK, UK50
C5	Capacitor, 330 pF @ 1000V	56-10215F331JC10	Centralab DD, C1, DC, CK, UK50
C7	Capacitor, 2200 mfd @ 16V	56-12396DT228M16	Siemens B41010/8212/8202
C8, 9	Capacitor, 100 mF @ 25V	56-10203-107N25	E.C.I. Type SM
C10, 11, 17	Capacitor, 10 mF @ 16V	56-12731E106N16	Siemens B45134
C12, 13	Capacitor, 0.02 mF @ 100V	56-10215N203KP1	Centralab DD, C1, DC, CK, UK50
C14, 15	Capacitor, 2.2 mF @ 16V	56-12731A225N16	Siemens B45134

MAIN BOARD (Cont'd.)

Ref. Des.	Description	USC Stock Number	Vendor
C51*	Capacitor, 1.0 mF @ 100V	56-10211-105J1	Packtron Type WC
C52*	Capacitor, 33 pF @ 1000V	56-10215A330JA10	Centralab DD, C1, DC, CK, UK50
D1	Diode, Dual	40-16800	Siliconix E7062
D2	Diode, Reference	40-14859	Centralab 1N825A
D3-8	Diode, Rectifier	40-07787-01	ITT EM 400 Series
F1	Fuse, Thermal	52-16830-096	Micro Devices 60961
F2	Fuse, 1/2 Amp	52-17936-05	Littlefuse, 275.500
IC1	Integrated Circuit, Analog Processor	40-16268	Siliconix LD111ACJ
IC2	Integrated Circuit, Digital Processor	40-16267	Siliconix LD110CJ
IC3	Integrated Circuit, Quad 2 Input NOR Gate	40-15950	Motorola 14001CP
IC4	Integrated Circuit, +12V	40-15325	Fairchild F78L12AC
IC5	Integrated Circuit, Neg 12V	40-16798	Motorola MC79L12C
IC6	Integrated Circuit, +5V Regulator	40-16501	Motorola 78M05C
IC7*	Integrated Circuit, Op Amp	40-14080	Fairchild LM308AH
Q1	Transistor, Silicon	40-11353	G.E. 2N5172
Q3	Transistor	40-09437	Fairchild 2N4248
R2	Resistor, 1K, 1/4W, 10%	55-10101HM001	IRC GBT-1/4
R3*	Resistor, 10K, 1/8W, 1%	55-10168EJK010	Dale Type MFF
R4, 7	Resistor, 120K, 1/4W, 10%	55-10101HK120	IRC GBT-1/4
R5*	Resistor, 10K, Pot/Trimmer	55-13261JK010	Dale 150SX

MAIN BOARD (Cont'd.)

Ref. Des.	Description	USC Stock Number	Vendor
R6	Resistor, 71.5K, 1/8W, 1%	55-10168EJK071R5	Dale Type MFF
R8	Resistor, 820 ohm, 1/4W, 5%	55-10101HA820	IRC GBT-1/4
R9	Resistor, 51K, 1/4W, 10%	55-10101HK051	IRC GBT-1/4
R10, 11	Resistor, 10K, 1/4W, 10%	55-10101HK010	IRC GBT-1/4
R12	Resistor, 82 ohm, 1/4W, 5%	55-10101HA082	IRC GBT-1/4
R13, 14, 20	Resistor, 47K, 1/4W, 10%	55-10101HK047	IRC GBT-1/4
R15*	Resistor, 47.5 ohm, 1/8W, 1%	55-10168ELA047R5	Dale Type MFF
R16	Resistor, 392K, 1/8W, 1%	55-10168ELK392	Dale Type MFF
RB, 21	Resistor, 10 ohm, 1/4W, 5%	55-10101HA010	IRC GBT-1/4
R51*	Resistor, 100K, 1/4W, 10%	55-10101HK100	IRC GBT-1/4
R52*	Resistor, 100K, 1/8W, 1%	55-10168EJK100	Dale Type MFF
R53*	Resistor, 900K, 1/4W, 1%	55-10164EJK900	Pyrofilm PME60
R54*	Resistor, 100K, Variable, 10%	55-13261JK100	Dale 150SX
R55*	Resistor, 56.2 ohm, 1/8W, 1%	55-10168ELK056R2	Dale Type MFF
T1	Transformer, Power	42-16928	USC
	Complete Board Assembly (2770A-00)	05-17845	USC
	Complete Board Assembly (all others)	05-16823-01	USC

*2770A-00 ONLY

EXTERNAL VOLTAGE RANGE RESISTORS

Ref. Des.	Description	USC Stock Number	Vendor
Model 2770A-01			
R3	Resistor, 10K, 1/8W, 1%	55-10168EJK010	Dale Type MFF
R15	Resistor, 47.5 ohm, 1/8W, 1%	55-10168ELA047R5	Dale Type MFF
Model 2770A-02			
R3	Resistor, 100K, 1/8W, 1%	55-10168EJK100	Dale Type MFF
R15	Resistor, 100 ohm, 1/8W, 1%	55-10168ELA100	Dale Type MFF
Model 2770A-03			
R36	Resistor, 9.99M, 1W, .1%	55-10165BJM009R99	Pyrofilm PME70
R37	Resistor, 1.1M, 1/2W, 1%	55-10111ELM001R1	Pyrofilm PME65
Model 2770A-04			
R36	Resistor, 9.99M, 1/8W, 0.1%	55-10165BJM009R99	Pyrofilm PME70
R37	Resistor, 100K, 1/2W, 0.5%	55-10111DJK100	Pyrofilm PME65
Model 2770A-05			
R36	Resistor, 9.99M, 1W, 0.1%	55-10165BJM009R99	Pyrofilm PME70
R37	Resistor, 10K, 1/2W, 0.5%	55-10111DJK010	Pyrofilm PME65
Model 2770A-08			
R36	Resistor, 1K, 1W, 0.5%	55-10121DDK001	Dale RS-1B
Model 2770A-09			
R36	Resistor, 100 ohms, 1W, 0.5%	55-10121DDA100	Dale RS-1B
Model 2770A-10			
R36	Resistor, 10 ohms, 1W, 0.5%	55-10121DDA010	Dale RS-1B
Model 2770A-11			
R36	Resistor, 1 ohm, 1W, 0.5%	55-10121DDA001	Dale RS-1B
Model 2770-12			
R36	Resistor, 0.1 ohm, 1W, 0.5%	55-10121DLA00R1	Dale RS-1B

DISPLAY BOARD

Ref. Des.	Description	USC Stock Number	Vendor
IC101	Integrated Circuit, H Lamp	40-15962	Fairchild 75492A
IC102	Integrated Circuit, Driver	40-17556	Motorola MC1413CP
IC103	Integrated Circuit, CMOS Decoder/Driver	40-16799	Motorola MC14511CP
LED 1	LED Display	40-17705	Monsanto MAN 6630GB
LED 2	LED Display	40-17706	Monsanto MAN 6610GB
Q102-105	Transistor, PNP	40-16253	Fairchild MPS4355
Q106	Transistor	40-09277	G E 2N5306
Q107	Transistor	40-11353	G E 2N5172
R101	Resistor, 360 ohm, 1/4W, 5%	55-10101HA360	IRC GBT-1/4
R102, 113	Resistor, 47K, 1/4W, 10%	55-10101HK047	IRC GBT-1/4
R103	Resistor, 39 ohm, 1/4W, 5%	55-10101HA039	IRC GBT-1/4
R104	Resistor, 56K, 1/4W, 10%	55-10101HK056	IRC GBT-1/4
R105, 106, 107, 108, 109, 110, 111	Resistor, 68 ohm, 1/4W, 5%	55-10101HA068	IRC GBT-1/4
R112	Resistor, 100K, 1/4W, 10%	55-10101HK100	IRC GBT-1/4
R114	Resistor, Potentiometer 250K	41-16821KLK250	Beckman 91W
R115	Resistor, 10 ohm, 1/4W, 5%	55-10101HA010	IRC GBT-1/4
	Complete Board Assembly	05-17702-03	USC

ALARM OPTION, OPTION "C"

Ref. Des.	Description	USC Stock Number	Vendor
C1-4	Capacitor, 100 pF @ 1000Vdc	56-10215F102JC10	Centralab DD, C1, DC, CK, UK50
C5, 7	Capacitor, 0.0015 mF @ 1000Vdc	56-10215B152JE10	Centralab DD, C1, DC, CK, UK50
C6	Capacitor, 390 pF @ 1000Vdc	56-10215F391JC10	Centralab DD, C1, DC, CK, UK50
D1-15	Diode, 1N4154	40-09297	Motorola 1N4154
IC1	Integrated Circuit, Dual 4 Input, NOR Gate	40-15949	Motorola MC14002CP
IC2, 4	Integrated Circuit, 4-Bit, Magnitude Comparator	40-15958	Motorola MC14585
IC3	Integrated Circuit, 4-Bit Shift, Register	40-15961	Motorola MC14015
IC5	Integrated Circuit, Dual 4 Channel, Data Selector Multiplexer	40-16841	Motorola MC14539
IC6	Integrated Circuit Dual Type, Flip/Flop	40-16840	Motorola MC14013
IC7	Integrated Circuit, Quad 2 Input AND Gate	40-15952	Motorola MC14081CP
IC8	Integrated Circuit, Hex Buffer	40-16839	Motorola MC14050
IC9	Integrated Circuit, Quad 2 Input, NAND Gate	40-15957	Motorola MC14011CP
IC10	Integrated Circuit, Quad Exclusive, OR Gate	40-15953	Motorola MC14507CP
Q1	Transistor	40-11439	G.E. 2N4424
R1-4, 7	Resistor, 100K, 1/4W, 5%	55-10101HK100	IRC GBT-1/4
R5, 8, 9, 10, 11, 19, 22, 26	Resistor, 1M, 1/4W, 5%	55-10101HM001	IRC GBT-1/4
R6, 12, 13, 14, 15, 20, 21, 23	Resistor, 10K, 1/4W, 5%	55-10101HK010	IRC GBT-1/4
R16, 17	Resistor, 47K, 1/4W, 5%	55-10101HK047	IRC GBT-1/4
R24	Resistor, 6.2K, 1/4W, 5%	55-10101HK006R2	IRC GBT-1/4
	Complete Board Assembly	05-16944	USC

SINGLE LINE ENABLE BCD, OPTION "E"

Ref. Des.	Description	USC Stock Number	Vendor
C1	Capacitor, 10 mF @ 15V	56-10222C106N15	S.E.L. Type SF
C2-15	Capacitor, 0.1 mF @ 35V	56-10222A104N35	S.E.L. Type SF
IC1	Integrated Circuit, CMOS, Inv Buffer	40-15956	Motorola MC14049CP
IC2-6	Integrated Circuit, CMOS Buss, Driver	40-16622	Motorola 4503CP
RM 1, 2	Resistor, Module, 470 ohm	55-16075FJA470	Beckman 899-3-R
R5	Resistor, 10K, 1/4W, 5%	55-10101HK010	IRC GBT-1/4
R6, 7	Resistor, 1K, 1/4W, 5%	55-10101HK001	IRC GBT-1/4
	Complete Board Assembly	05-16934	USC

STANDARD BCD, OPTION "N"

Ref. Des.	Description	USC Stock Number	Vendor
C1	Capacitor, 10 μF @ 6.3V	56-12731C10-N06R3	Siemens B45134
C2	Capacitor, .056 μF @ 250V	56-15617J563J2R5	Mepco/Electra C350
C3-7	Capacitor, 0.001 mF @ 1Kv	56-10215B102UT10	Centralab DD, C1, DC, CK, UK50
IC1	Integrated Circuit, Hex Buffer	40-16839	Motorola MC14050
IC2	Integrated Circuit, Quad 2 Input NAND Gate	40-15957	Motorola MC14011CP
IC3	Integrated Circuit, CMOS, Hex Inverter	40-15421	National Semiconductor 74C04
IC4	Integrated Circuit, Low Power, JK Flip/Flop	40-14286	Fairchild 9L24
IC5-8	Integrated Circuit, Low Power, 4-Bit Latch	40-14289	Fairchild 93L14
R1-5	Resistor, 100K, 1/4W, 5%	55-10101HK100	IRC GBT-1/4
R6-8	Resistor, 10K, 1/4W, 5%	55-10101HK010	IRC GBT-1/4
	Complete Board Assembly	05-17866	USC

OPTION "R"

Ref. Des.	Description	USC Stock Number	Vendor
C7	Capacitor, 47 μF @ 6.3V	56-12731G476N6R3	Siemens B45134
C50, 51	Capacitor, .01 μF @ 250V	56-16873-103H2R5	Siemens Type MKH
D3-6	Diode, Signal	40-09297	Motorola 1N4154
Q4, 5	Transistor, Power	40-15323	Motorola 15323
R24, 25	Resistor, 2K, 1/4W, 5%	55-10101HK002	IRC GBT-1/4
R52, 53	Resistor, 15 ohm, 1/4W, 5%	55-10101HA015	IRC GBT-1/4

Miscellaneous Parts

Case, White	30-13237-01
Window	30-16327
Mask, Window	39-17776
Key, Polarizing	51-11797
Connector, line/analog input	51-07548-15
Connector, BCD ("E" & "N" option)	51-07548-12
Anti-Static Strip	51-16929-02R5

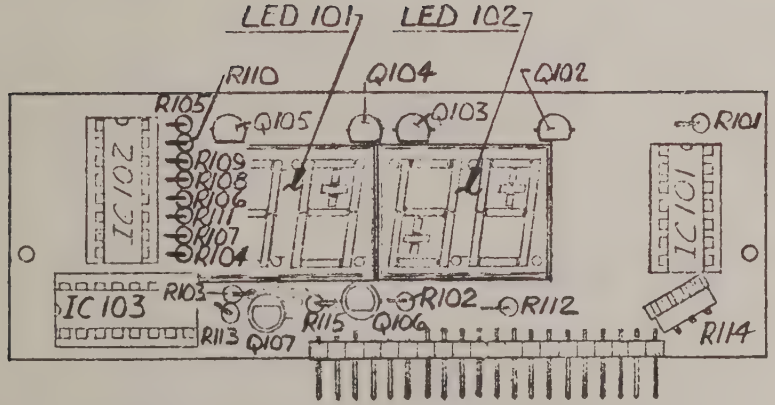


Figure 13
Component Location, Display Board

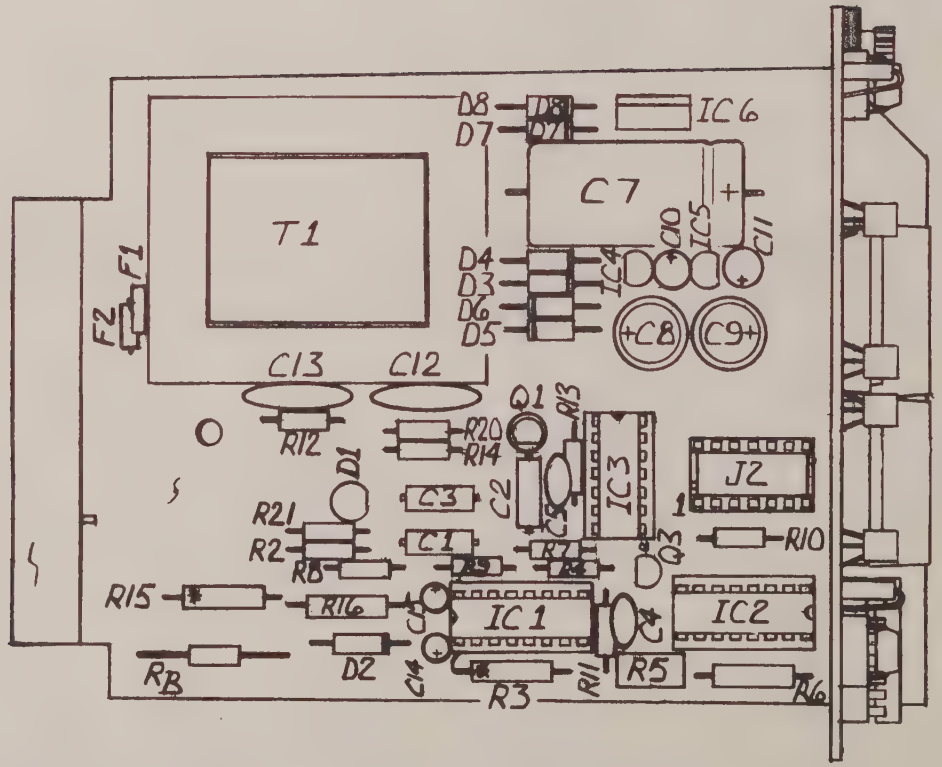


Figure 14
Component Location, A/D Board

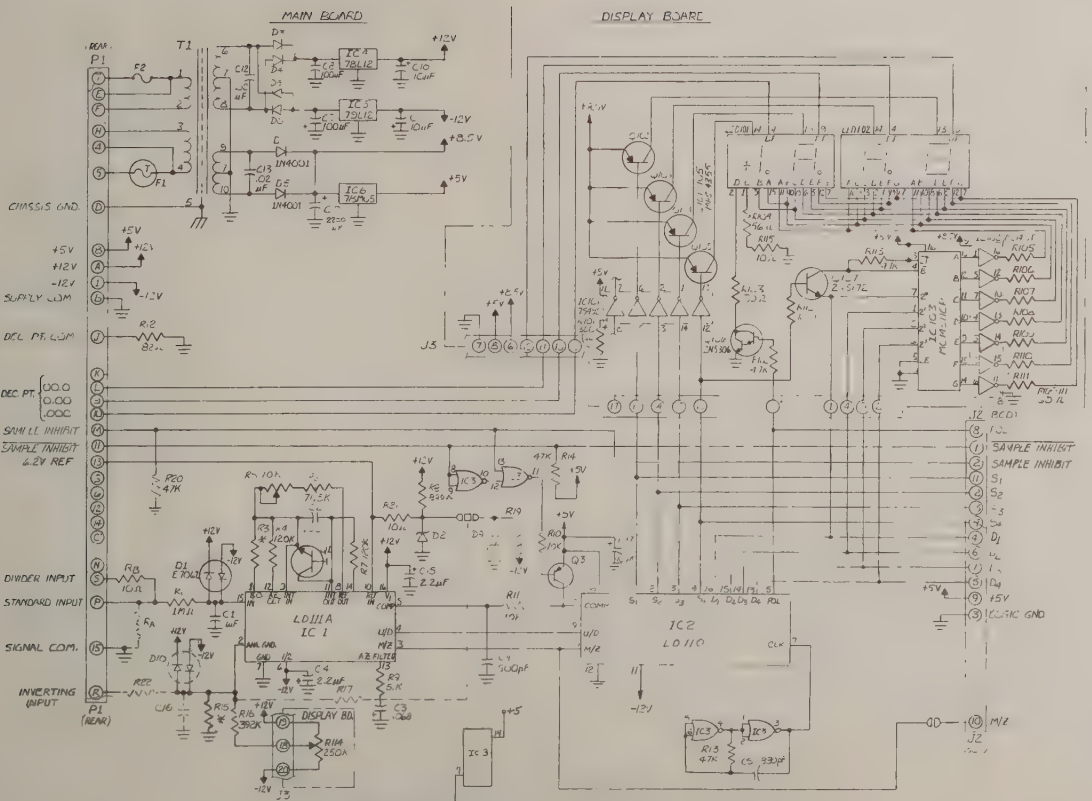


Figure 15
Schematic A/D Board

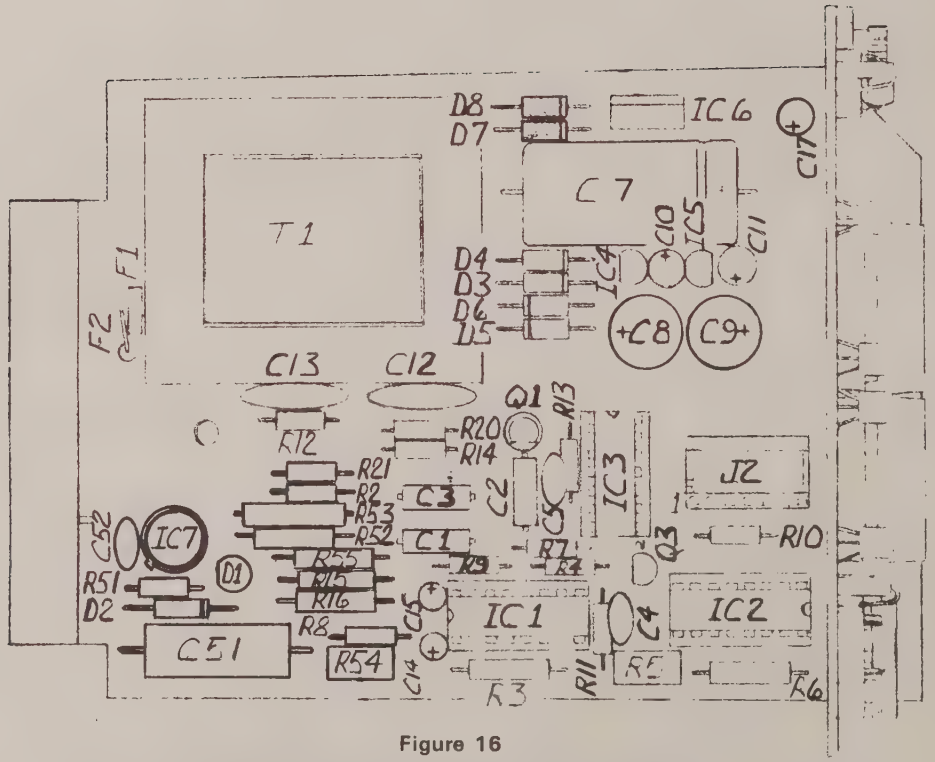


Figure 16
Component Location A/D Board (2770A-00 only)

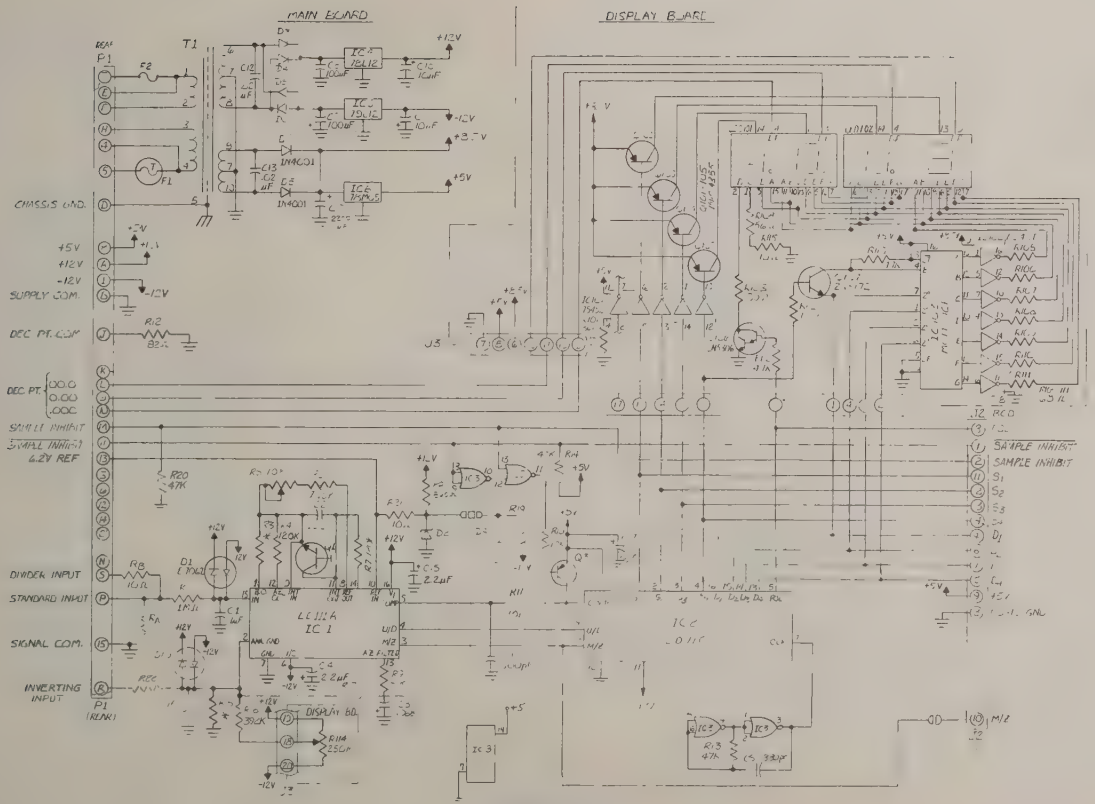


Figure 17
Schematic, A/D Board (2770A-00 only)

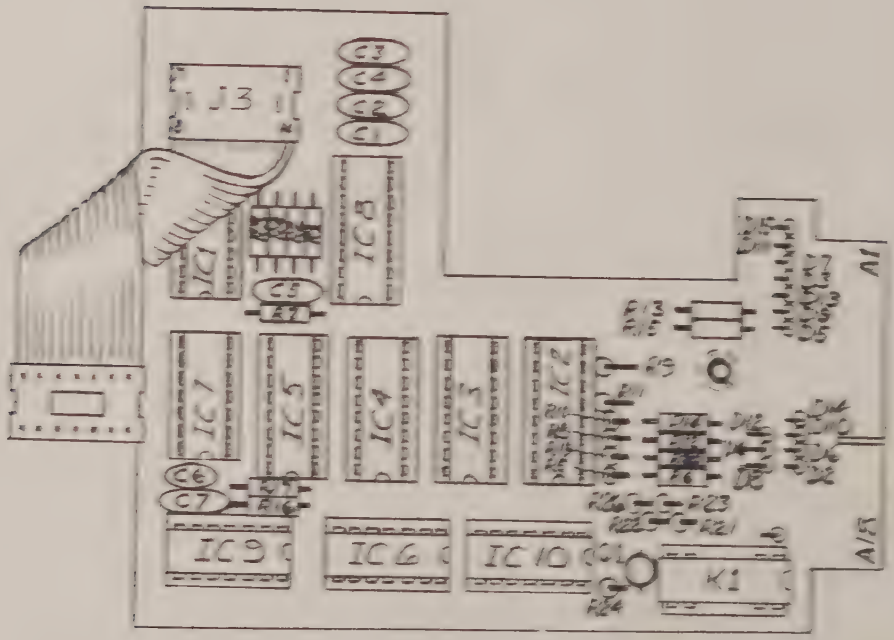
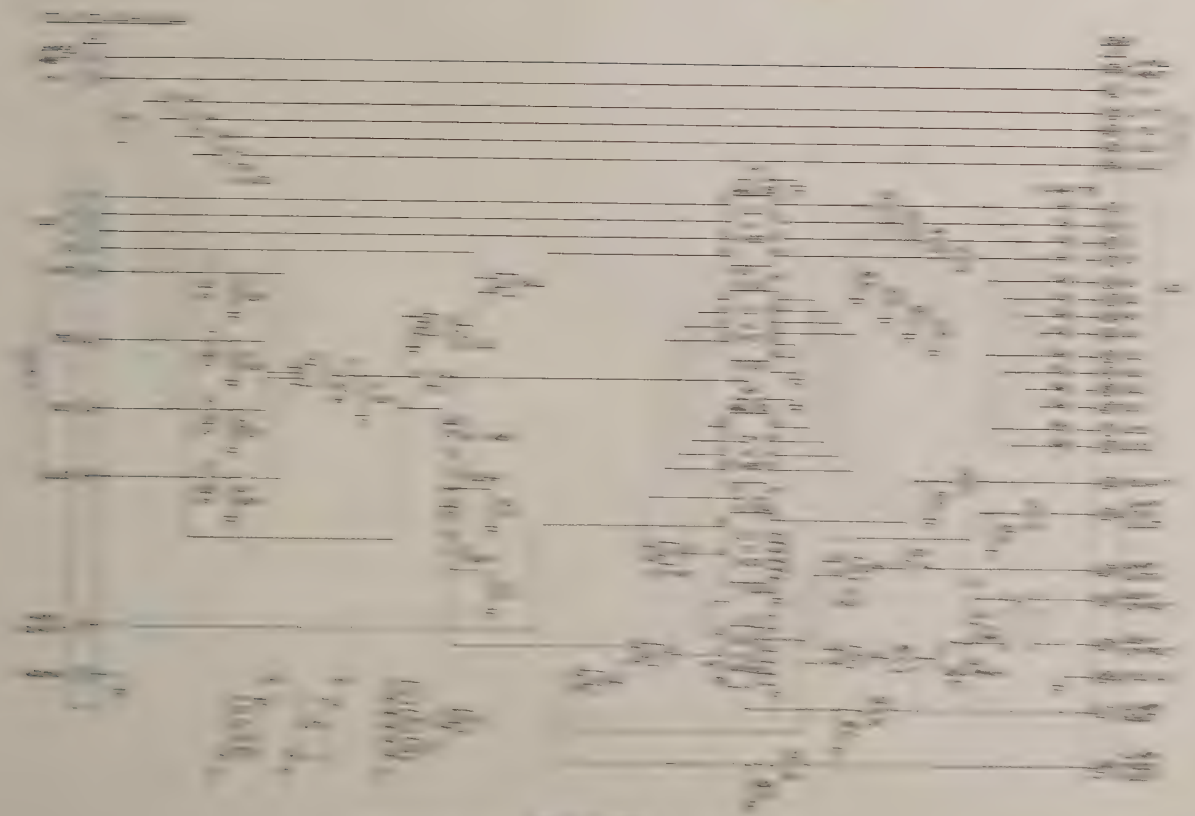


Figure 18
Component Location, Comparator Alarm Option "C"



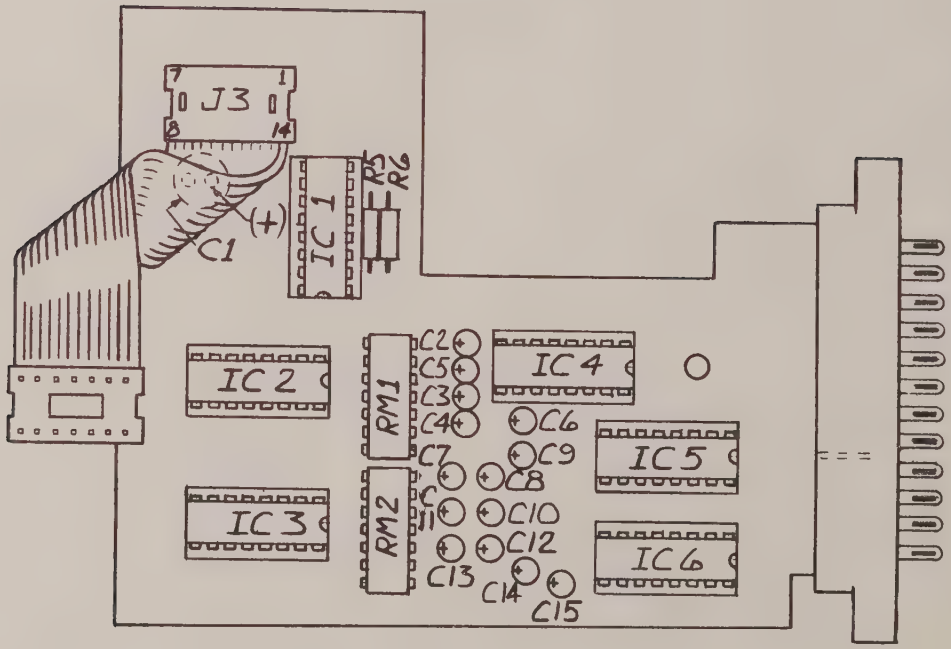


Figure 20
Component Location, Single Line BCD, Option "E"

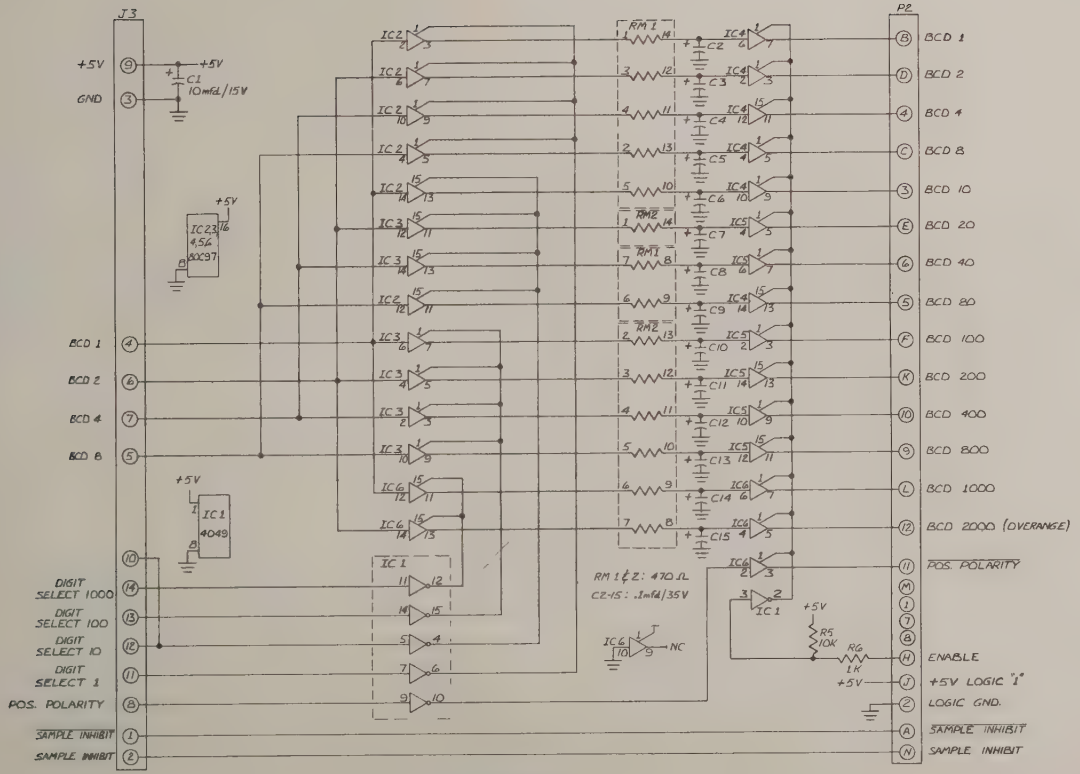


Figure 21
Schematic, Single Line Enable BCD, Option "E"

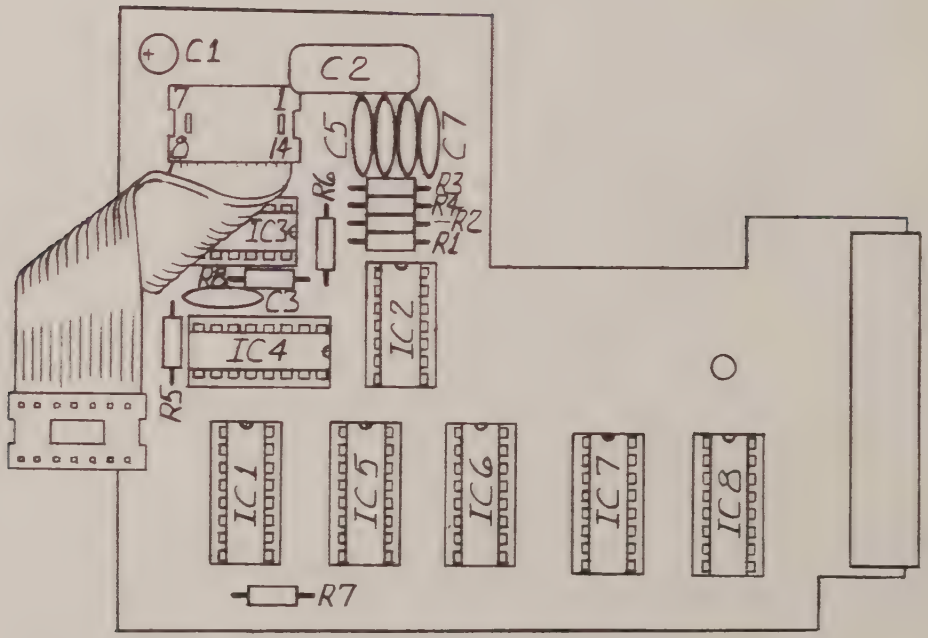


Figure 22
Component Location, Standard BCD, Option "N"

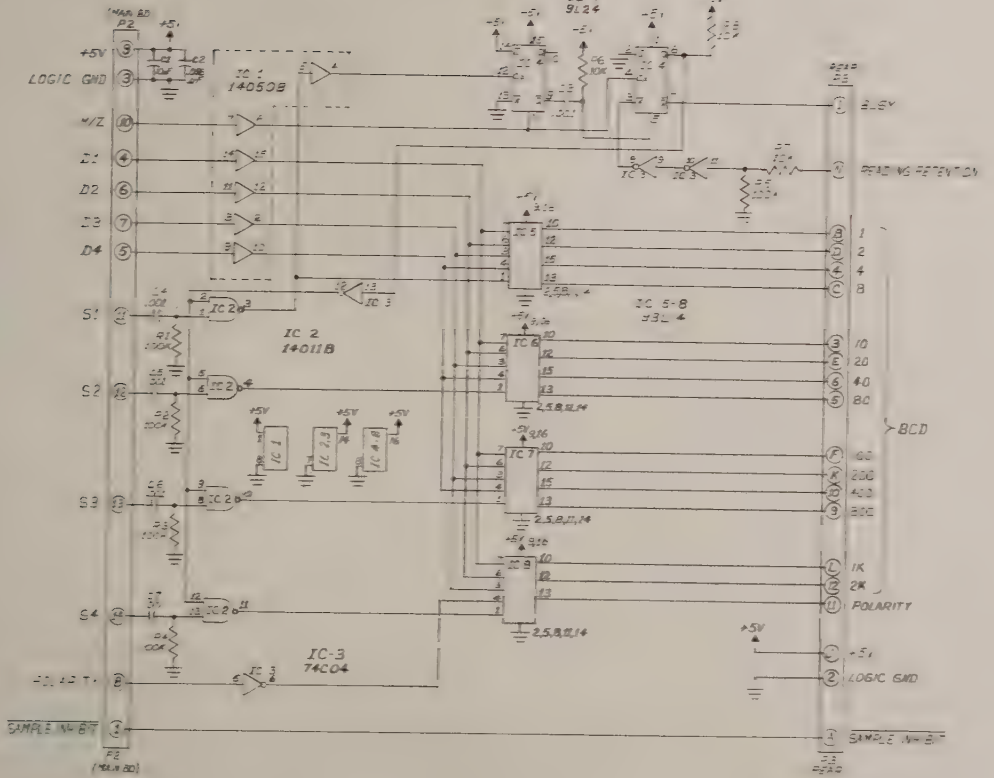


Figure 23
Schematic Standard BCD, Option "N"

WARRANTY

UNITED SYSTEMS CORPORATION warranties that each instrument and other articles of equipment manufactured by USC to be free from defects in material and workmanship, when subjected to normal use and service. This warranty is expressly limited to the servicing and/or adjusting of USC supplied equipment (i.e. USC is not liable for damage to customer supplied equipment interfaced with USC equipment) returned, freight prepaid, to the factory or to the nearest factory authorized service center within one year from date of delivery; and to the repairing, replacing or adjusting of parts (excepting lamps, fuses, batteries, probes and electro-mechanical assemblies) which upon examination shall be found defective. This warranty shall not apply to any instrument or other article of equipment which has been repaired or altered outside of USC factory or authorized service stations nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation of use not in accord with instructions furnished by the manufacturer.

Material on electro-mechanical assemblies is warranted for 1 year from the date of delivery while labor is warranted for 90 days from the same date.

This warranty is expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and UNITED SYSTEMS CORPORATION neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products beyond that specifically provided hereinabove.

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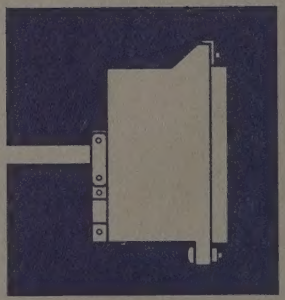

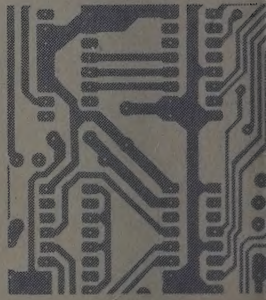

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